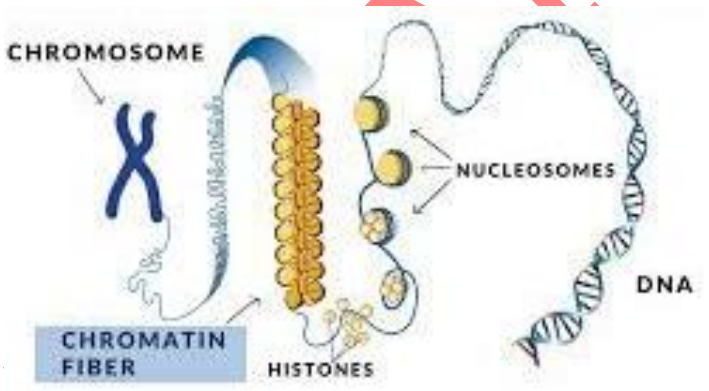
CELL CYCLE AND CELL DIVISION

The nucleus contains most of the cell's DNA which is organized into discrete units called chromosomes. Each chromosomes contains one long DNA molecule associated with many proteins. This complex of DNA and proteins is called the chromatin.

When cell is not dividing chromatin appears as long thread.

When cell is dividing chromatin they get highly coiled and condensed to form chromosomes.



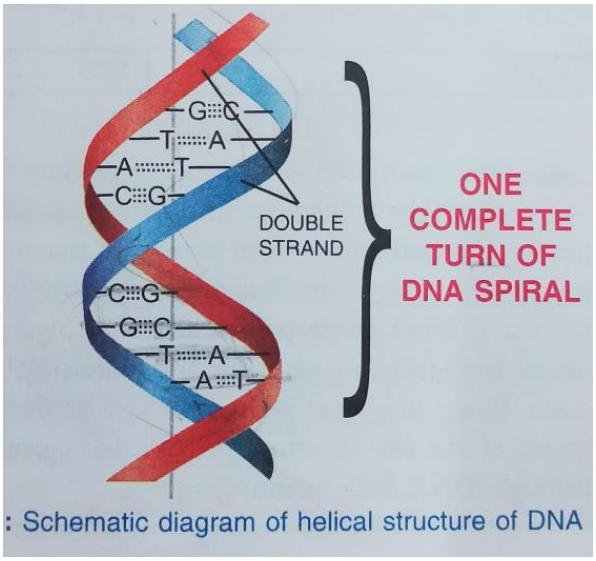
Chroma ----coloured body, Soma --- body

Discovery of Chromosomes:

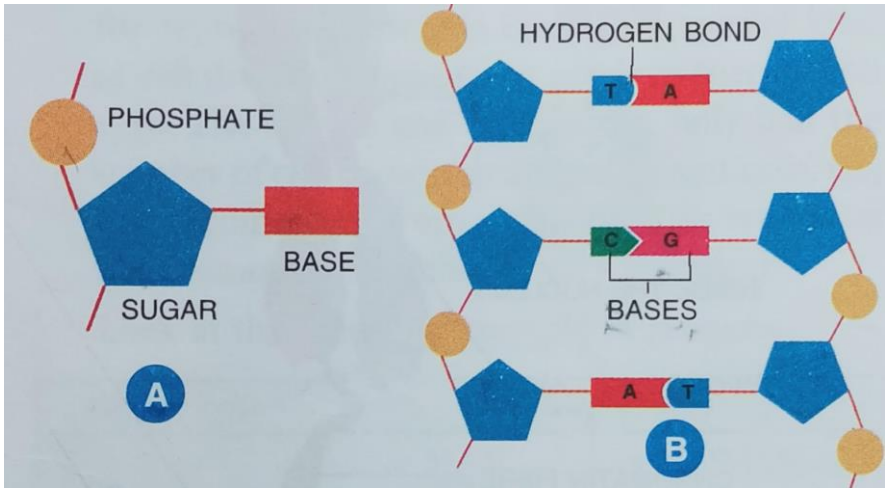
Walther Flemming discovered the rapidly dividing cells of larvae of salamander. He called the division as *mitosis* meaning thread.

Chromatin:

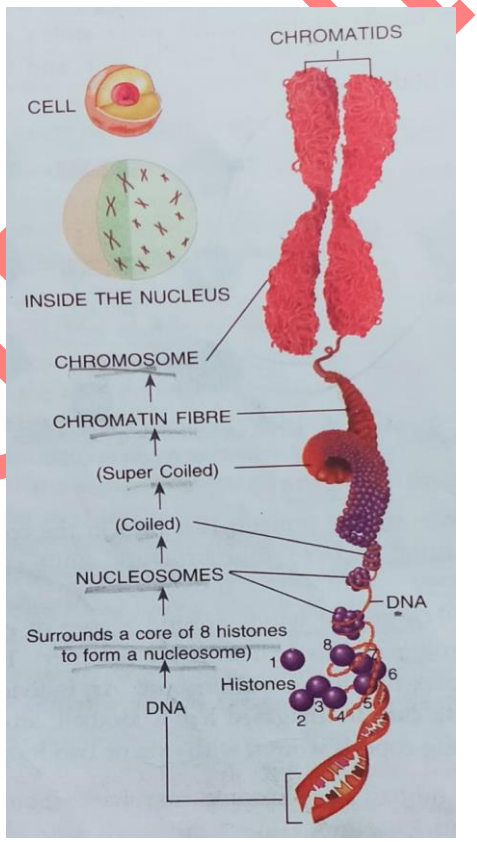
The chromatin material that constitutes the fibre is formed of two substances.
i) DNA: DNA is made up of repeating nucleotides which are made of phosphate, sugar (pentose), and nitrogenous base. Joined to other strand by complementary nitrogenous base. Four types of base are: Adenine, Guanine, Cytosine, Thymine.



: Schematic diagram of helical structure of DNA

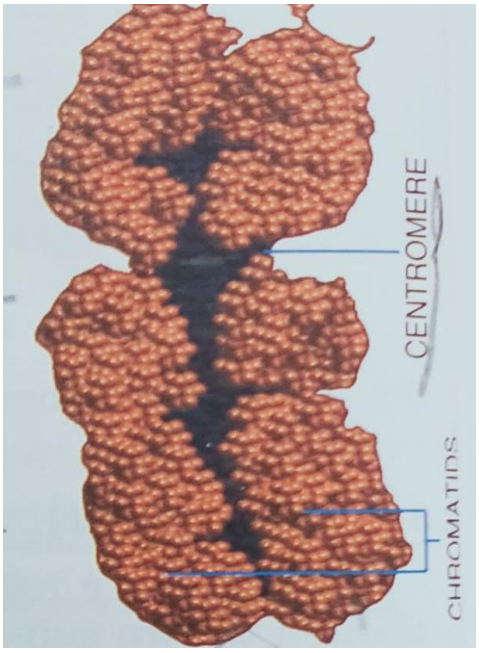


ii) Histones: **Histones are proteins that help in coiling and packaging of DNA into structural units called nucleosome. Nucleosomes which contain eight histone proteins.**



Structure of Chromosomes:

Each chromosome in its condensed form as visible during the start of cell division, consists of two sister chromatids, joined at some point along the length. This point of attachment is called centromere. It serves to attach spindle fibre during cell division.



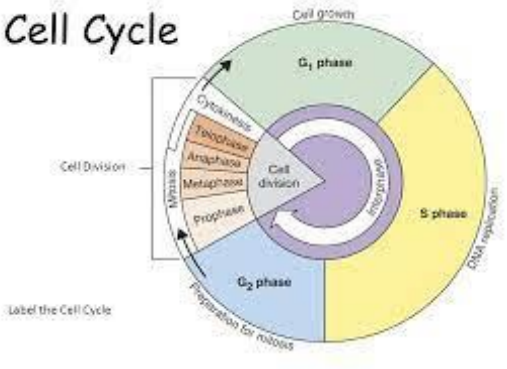
Genes: **Genes are specific sequences of nucleotides on a chromosome, that encode particular proteins which express in the form**

of some particular feature of the body. They are the units of heredity which are transferred from parents to offspring's and are responsible for some specific characteristics of the offspring.

Need For New Cells:

1. For Growth
2. For Replacement
3. For Repair
4. For Reproduction

Cell Cycle – Divide, Grow and Redivide:

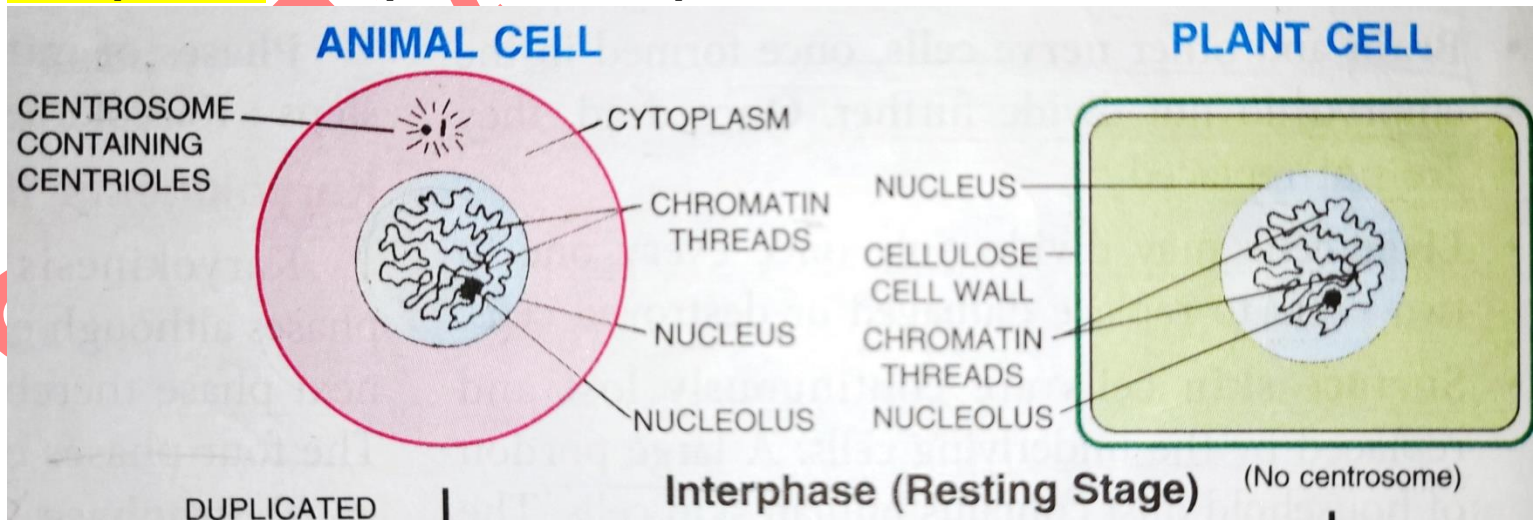


The cell cycle is a series of events that take place in a cell leading to the duplication of its DNA and the subsequent division of the cell to produce two daughter cells.

Cell Cycle consists of two phases:

A) a non dividing phase called the interphase
B) a dividing phase called the M – Phase.

Interphase: Interphase has 3 phases:



i) First Growth Phase – No change in Chromosomes is visible so it is called resting phase.

ii) Synthesis Phase – DNA synthesis and chromosomes are

duplicated.

iii) Second Growth Phase- More RNA synthesis

Cell Division: There are two types of cell divisions:

1. Mitosis: Cell division leading to the production of diploid cells for growth and development.

2. Meiosis: Cell division leading to the production of haploid cells or gametes (sperms or egg).

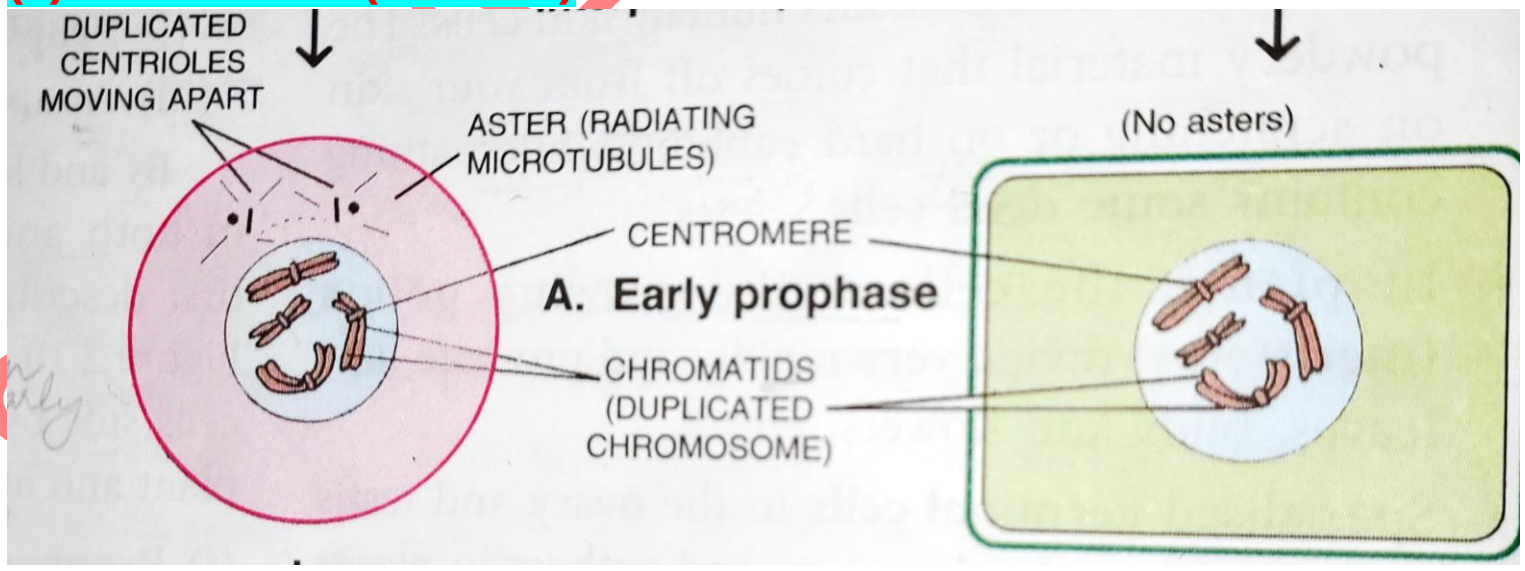
Mitosis: MITOSIS is the cell division in which one parent cell divides into two identical daughter cells.

The most important aspect of mitosis is that the same normal chromosome number is maintained at each cell division.

Phases of Mitosis: Mitosis is completed in two steps: Karyokinesis and Cytokinesis

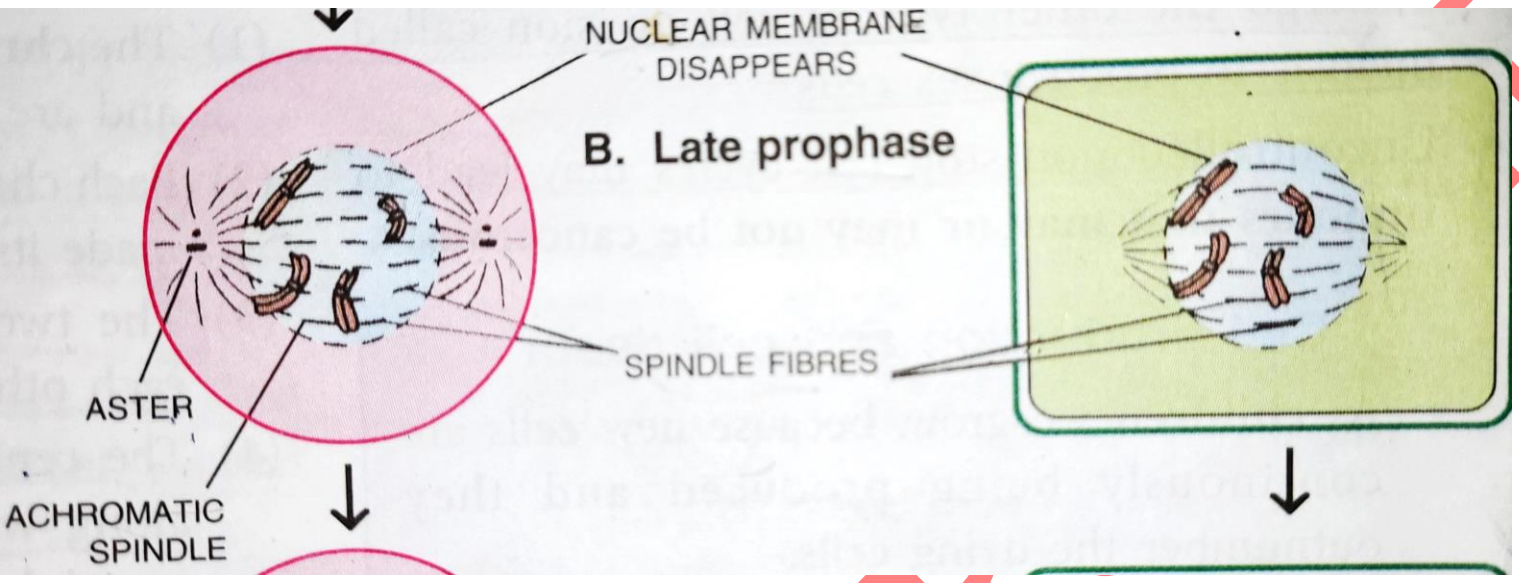
Karyokinesis (Division of Nucleus): It has 4 phases:

(1) PROPHASE (A and B)

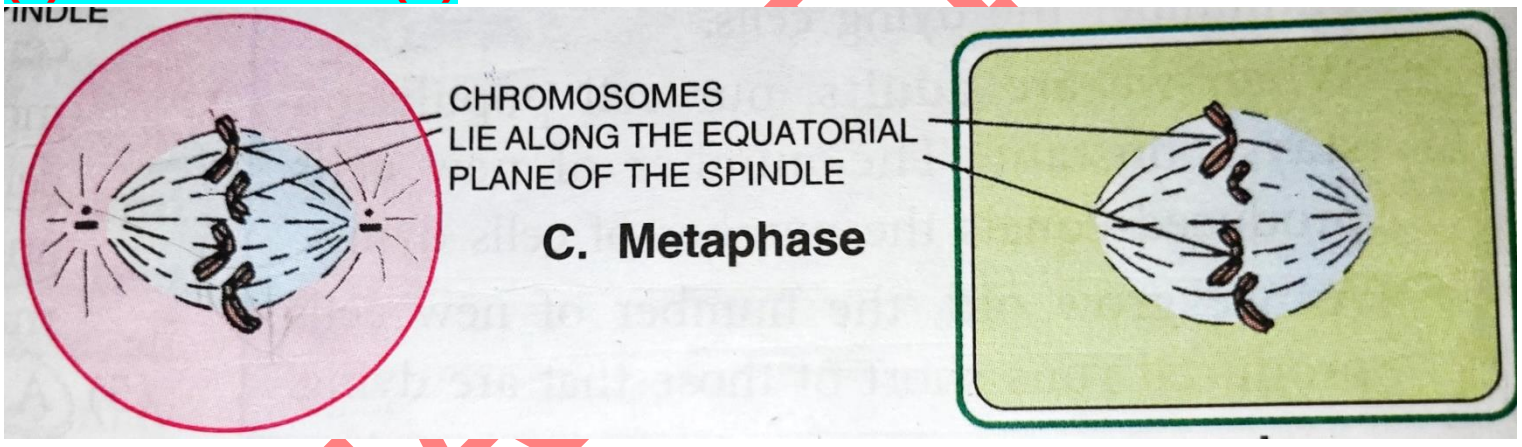


- Centrioles start moving apart and reach opposite poles.
- Chromosomes become distinct.
- Chromosomes are already duplicated as paired chromatids.

- **Sister chromatids attached to each other at a small region called centromere.**
- **Spindle fibres appear between daughter centrioles forming the achromatic spindle.**
- **Nuclear membrane and nucleolus disappear.**

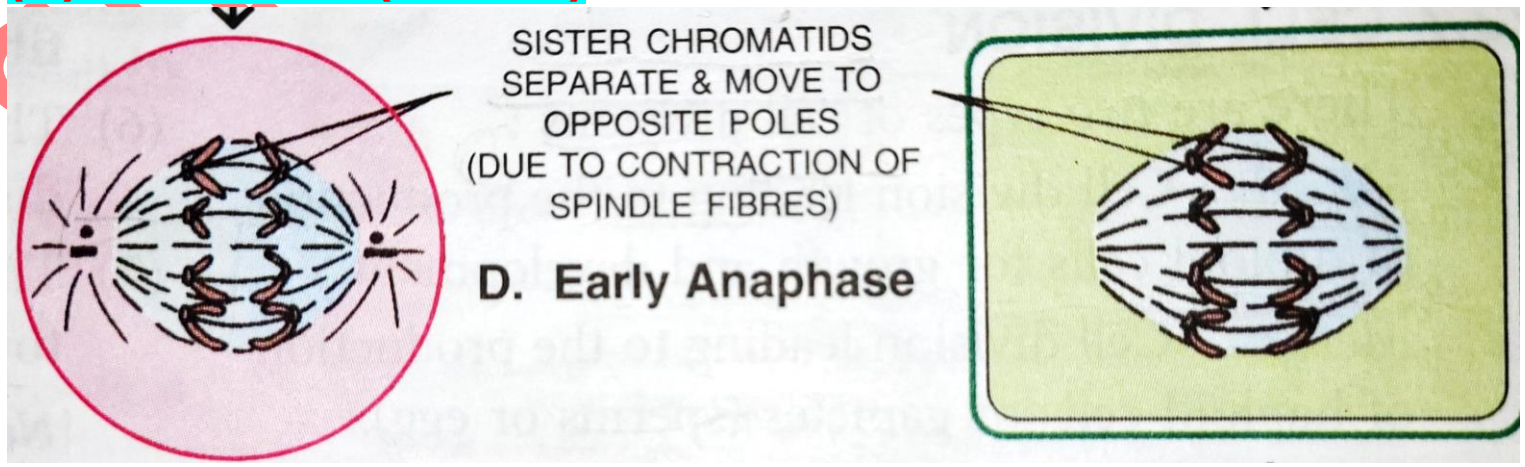


(ii) METAPHASE (C)

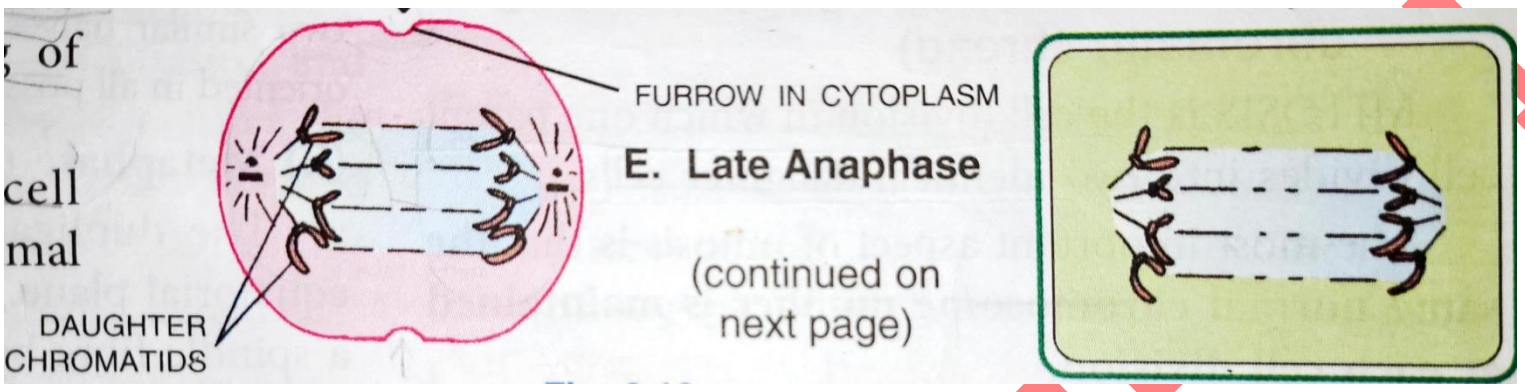


- **Each chromosome gets attached to spindle by its centromere.**
- **Chromosomes line up in one plane at equator.**

(iii) ANAPHASE (D and E)

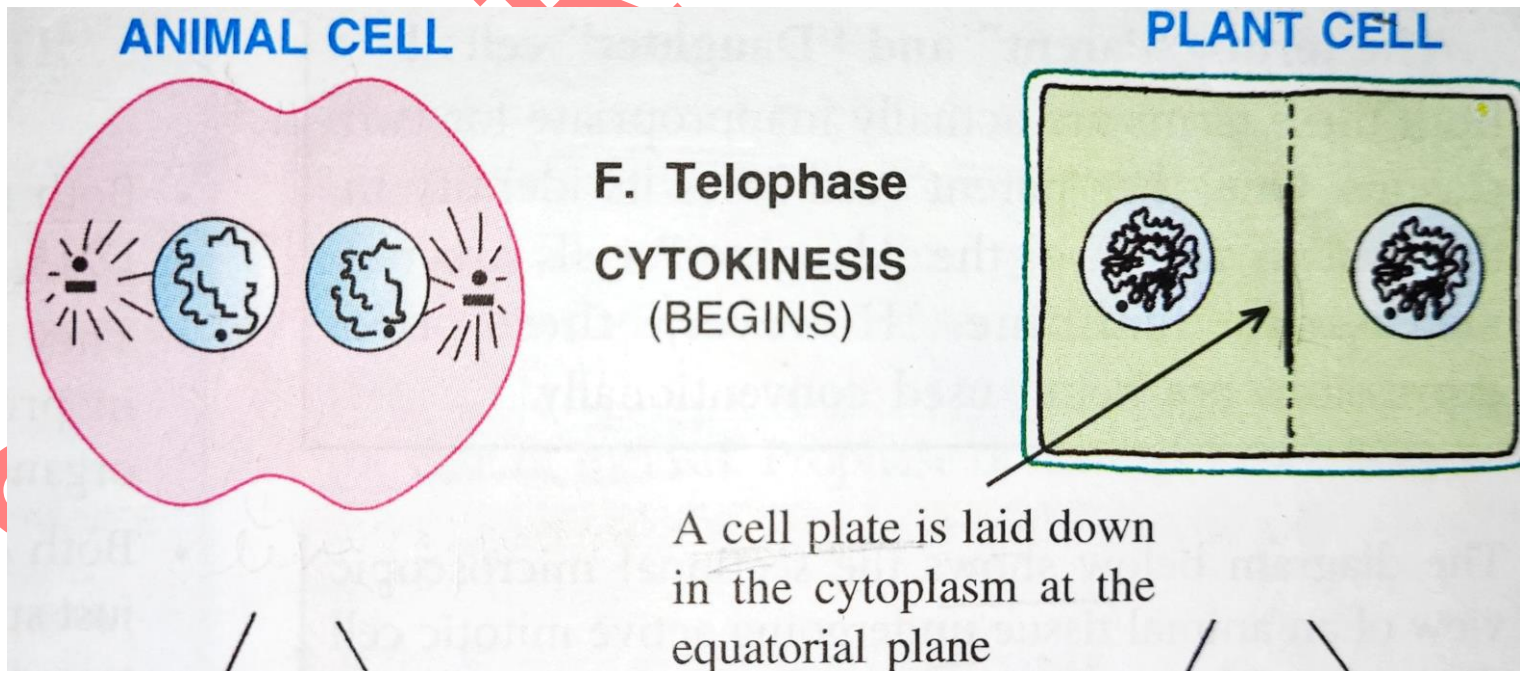


- **Centromere attaching the two chromatids-divides/splits.**
- **The two sister chromatids of each chromosome separate and are drawn apart towards opposite poles pulled by shortening of spindle fibres.**
- **A furrow starts in the cell membrane at the middle in animal.**

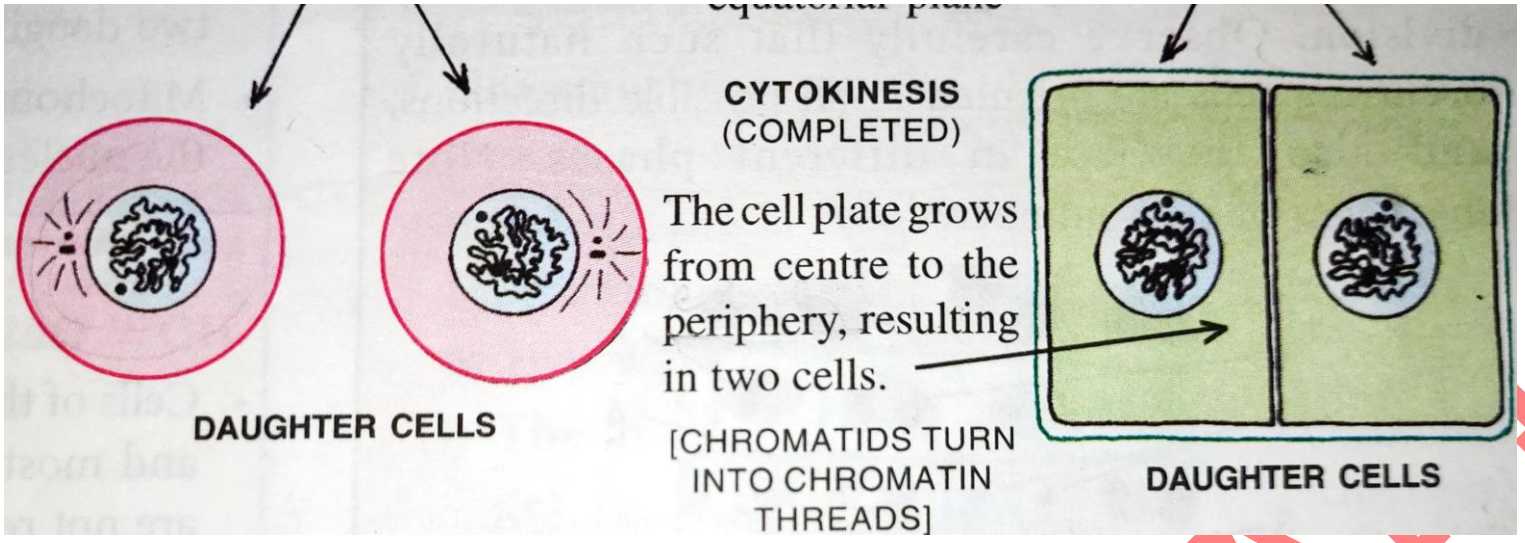


(iv) TELOPHASE (F)

- **Two sets of daughter chromosomes reach opposite poles.**
- **Spindle fibres disappear.**
- **Chromatids thin out in the form of chromatin fibres.**
- **Nuclear membrane is formed.**
- **The cleavage furrow starts deepening in the animal cell.**
- **Nucleoli reappear.**



CYTOKINESIS (Division of cytoplasm)



Cleavage furrow deepens totally in animal cell and separates the two daughter cells.

Significance of Mitosis:

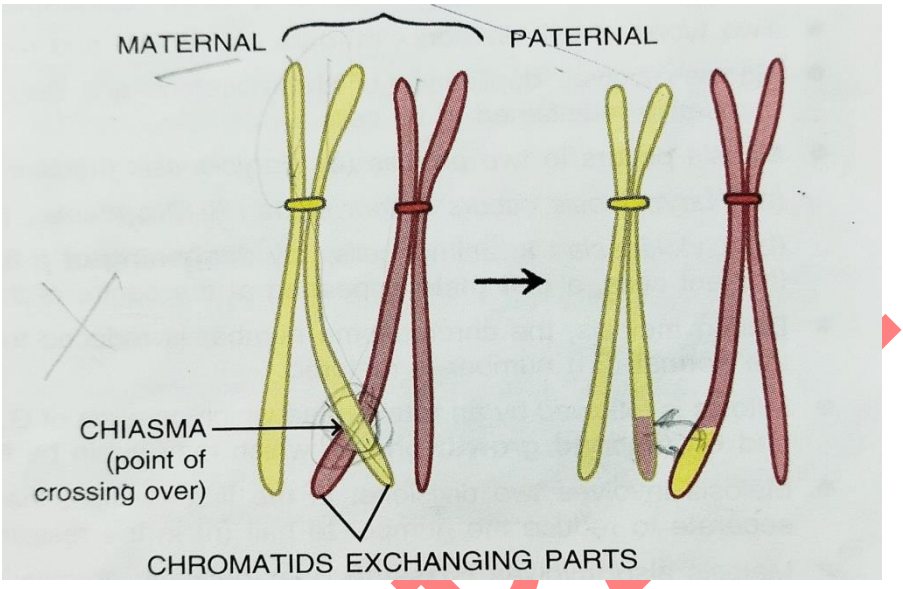
1. Growth
2. Repair
3. Replacement
4. Asexual
5. Same chromosome number in daughter cells

Meiosis: Meiosis (meion = to lessen, referring to the reduction of the chromosome number) is the kind of cell division that produces the sex cells or the gametes. It takes place in the reproductive organs.

Significance of Meiosis

1. Chromosome number is halved in gametes (sex cells), so that on fertilization, the normal number (2n) is restored.
2. It provides for mixing up of genes which occurs in two ways:

(i) The maternal and paternal chromosomes get mixed up during the first (reduction) division as they separate from the homologous pairs.



(ii) While the maternal and paternal chromosomes are separating, the chromatid material very often gets exchanged between the two members of a homologous pair. This is known as crossing over which results in genetic recombination. Chiasma (plural: chiasmata) is the X-shaped structure formed due to crossing over between the non-sister chromatids of the paired homologous chromosomes.

	Mitosis	Meiosis
1. Where it occurs	in the somatic (body) cells.	in reproductive cells.
2. What for	to provide for growth and replacement.	only for gamete formation.
3. When it occurs	continuously throughout life.	only in reproductively active age.
4. Number of daughter cells produced	two daughter cells.	four daughter cells.
5. Number of chromosomes passed on to each daughter cell	full set of chromosomes is passed on to each daughter cell. This is the diploid (2n) number of	Only half the number of chromosomes (only one member from each pair) is passed on to each daughter cell. This is

	chromosomes.	the haploid (n) number of chromosomes.
6. Number of nuclear divisions	a single nuclear division after chromosome duplication.	two nuclear divisions after chromosome duplication.
7. Identity of chromosomes and genes in daughter cell	identical.	randomly assorted between the gametes produced. This results in genetic variations.